

composite unit, in which a slit-shaped gas channel (7) formed by the first electrode face (4.2) facing away from the membrane electrolyte (6) and the first housing part (2.1) and is flowed through by a vapor-saturated, ion-generating carrier gas [G,V] with the vapor component, in which a slit-shaped liquid channel (8) formed by the second electrode face (5.2) facing away from the membrane electrolyte (6) and the second housing part (2.2) which is flowed through by the vapor-absorbing solution [S] and the electrodes (4,5) are electrically short-circuited by current lead-in and lead-off systems (9,10) and an external load resistor (11), in which via openings (12.1, 12.2) in the first housing part (2.1) vapor-saturated carrier gas [G,V]<sub>r</sub> with high vapor partial pressure is fed to the gas channel (7) and a reduced quantity of vapor-saturated carrier gas [G,V]<sub>m</sub> with reduced vapor partial pressure is carried off, via openings (13.1, 13.2) in the second housing part (2.2) an undersaturated solution [S]<sub>p</sub> with lower vapor concentration and a low vapor partial pressure is fed to the liquid channel (8) and a two-phase mixture [S]<sub>r</sub>, [G,V]<sub>p</sub> of undersaturated solution with raised vapor concentration and low vapor partial pressure and vapor-saturated carrier gas with the same low vapor partial pressure is carried off, so that when use is made of a cation-generating carrier gas type with the vapor component and a membrane electrolyte (6) selectively letting through this cation type, cations are formed at the phase boundary (4.1) (gas/solid/electrolyte) of the first electrode (4) as a result of anodic oxidation with the consumption of carrier gas and vapor from the gas channel (7), these migrate through the membrane electrolyte (6) to the second electrode (5) and at its phase boundary (5.2) (gas/liquid/solid) increase the concentration of

the solution flowing in the liquid channel (8) as a result of cathodic reduction with the liberation of an equivalent quantity of carrier gas, whilst the electrons from the first electrode (4) flow via the current conduction systems (9,10) and the external load resistor (11) to the second electrode (5) or that, when use is made of an anion-generating carrier gas type with the vapor component and a membrane electrolyte (6) selectively letting through this anion type, anions are formed at the phase boundary (4.1) (gas/solid/electrolyte) of the first electrode (4) as a result of cathodic reduction with the consumption of carrier gas and vapor from the gas channel (7), these migrate through the membrane electrolyte (6) to the second electrode (5) and at its phase boundary (5.2) (gas/liquid/solid) increase the concentration of the solution flowing in the liquid channel (8) as a result of anodic oxidation with the liberation of an equivalent quantity of carrier gas, whilst the electrons from the second electrode (5) flow via the current conduction systems (9,10) and the external load resistor (11) to the first electrode (4).

*The galvanosorptive reaction*

~~10. Process according to claim 9<sup>20</sup> in which the galvanic reaction cell, apart from the ion-generating and system pressure equalizing carrier gas with <sup>1a</sup>the vapor component involved in the galvanosorptive reaction process, thermally decomposable into a vapor component and a liquid component vapor-absorbing solution can be fed to and carried off, whereby hydrogen is a cation-generating carrier gas type with the vapor component and oxygen is an anion-generating carrier gas type with the vapor component and the substance system involved in the galvanosorptive reaction process as a whole is at least a ternary one, whereby the~~

structural materials of the reaction cell behave inertly in respect of the substance system [selected]. <sup>33</sup> wherein

D -- ~~11~~ Process according to claim <sup>33</sup> 10, characterized therein that an electrolytic component with negligible inherent vapor pressure soluble in the solvent and increasing the ion-conductivity, is added to the ternary substance system.

D -- ~~12~~ Process according to claim <sup>33</sup> 10, characterized therein that the galvanosorptive reaction process taking place in the reaction cell is run adiabatically or non-adiabatically, whereby in the case of non-adiabatic running of the process the electrode in contact with the solution is used whose current conduction system has channels distributed uniformly over its area through which a heat transfer medium flows, whose heat-transferring walls are medium-impermeable. <sup>wherein</sup>

<sup>rate of</sup> D -- ~~13~~ Process according to claim 12, <sup>wherein</sup> characterized therein that the substance phase quantities conveyed in the circuit by media-conveying devices are measured so that in the galvanosorptive reaction process a constant <sup>rate of</sup> [remaining] increase in concentration or dilution of the solution and a constant [remaining] vapor depletion of the carrier gas is established, whereby the overall system pressure is adjusted by the carrier gas filling of the circuit and the latter is at the same level as or higher than the upper vapor partial pressure reached in the ternary substance circulation.

D -- ~~14~~ Process according to claim <sup>33</sup> 10, <sup>wherein</sup> characterized therein that an activation voltage source is assigned to the electrodes which permanently confers on <sup>the electrodes</sup> them a quasi electrostatic potential difference [of several volts], whereby this potential

difference is superimposed on the inherent voltage difference of the cell.

C -- 5. <sup>wherein</sup> Process according to claim 12, characterized therein that the substance flows fed to and carried off from the galvanic reaction cell (40) with external load resistor (41) are formed into an isobaric, ternary substance circuit with external thermal substance decomposition and external phase separation thereby that a heated gas vapor enricher (42) combined with a phase separator, a solution recuperator (43), a solution cooler (44), a phase separator (45), a solution pump (46) and a gas compressor (47), whereby the two-phase mixture [S]r, [G,V]p carried off from the reaction cell (40) is fed above the bottom to the phase separator (45) and the phases [S]r and [G,V]p are separated, the vapor-depleted gas [G,V]p carried off at the head of the phase separator (45) is united with the moderately vapor-depleted gas [G,V]m carried off from the reaction cell and the mixture [G,V]x is fed by the gas compressor (47) to the gas vapor enricher (42) at the bottom and in the latter is conveyed towards the heated vapor-depleting solution [S]r with vapor uptake and the vapor-enriched gas [G,V]r carried off at the head of the gas vapor enricher (42) is fed again to the reaction cell (40), whilst the vapor-enriched solution [S]r carried off at the bottom from the phase separator (45) is conveyed by the solution pump (46) through the secondary side of the solution recuperator (43) (41) and introduced at the head into the gas vapor enricher (42) and the vapor-depleted solution [S]p is carried off at the bottom of the gas vapor enricher (42), passed through the primary side of the solution recuperator (43) and through the solution cooler (44) and fed again to the reaction cell (40).

32 *wherein*  
C ~~16~~ Process according to claim ~~13~~ [13] characterized therein that the substance flows fed to and carried off from the reaction cell (50) with external load resistor (56) and connected activation source (57) are formed into an isobaric, ternary substance circuit with external thermal substance decomposition and external phase separation by the allocation of a heated solution heater (51), a gas vapor enricher (52) combined with a phase separator, a phase separator (53), a solution pump (54) and a gas compressor (55), whereby the two-phase mixture [S]r, [G,V]p carried off from the reaction cell (50) is fed *above the bottom* to the phase separator (53) and the phases [s]r and [G,V]p are separated, the vapor depleted gas [G,V]p carried off at the head of the phase separator (53) is united with the moderately vapor-depleted gas [G,V]m carried off from the reaction cell and the mixture [G,V]x is fed by the gas compressor (55) to the gas vapor enricher (52) *at the bottom and* in the *latter* *gas vapor enricher* is conveyed towards the heated and vapor-depleting solution [S]r with vapor uptake and the vapor-enriched gas [G,V]r carried off at the head of the gas vapor enricher (52) is fed again to the reaction cell (50), whilst the vapor-enriched solution [S]r carried off at the bottom of the phase separator (53) is conveyed by the solution pump (54) through the solution heater (51) and introduced at the head into the gas vapor enricher (52) and the vapor-depleted solution [S]p carried off at the bottom of the gas vapor enricher (52) is fed again to the reaction cell (50).

D ~~17~~ Process for the conversion of sorptive reaction work into useful electrical work by means of a galvanic liquid electrolyte reaction cell (20) in which a ternary substance system consisting of a vapor/carrier gas mixture and a solution absorbing

the vapor are fed in and carried off and a cell housing (21) which contains a flat-shaped, mechanically stable, porous, gas-permeable first electrode (23) and a flat-shaped slitless second electrode (24) adjacent to the housing part (21.2), divided by a media-sealing, galvanically separating peripheral seal (22) into a first housing part (21.1) and a second housing part (21.2), in which a slit-shaped gas channel (25) formed by the surfaces of the first electrode housing part (21.1) and the first electrode (23) facing one another, is flowed through by a vapor-saturated, ion-generating carrier gas [G,V] with the vapor component, and a slit-shaped liquid channel (26) formed by the electrode surfaces facing one another and flowed through by the vapor-absorbing, ion-conducting solution [S] and the electrodes (23,24) are electrically short-circuited by current lead-in and lead-off systems (27,28) and an external load resistor (29), in which via openings (30.1, 30.2) in the first housing part (21.1) vapor-saturated carrier gas [G,V]<sub>r</sub> with <sup>a first</sup> (high) vapor partial pressure is fed to the gas channel (25) and a reduced quantity of vapor-saturated carrier gas [G,V]<sub>m</sub> with <sup>a second</sup> [reduced] vapor partial pressure is carried off, via openings (31.1, 31.2) in the second housing part (21.2) an undersaturated solution [S]<sub>p</sub> with reduced vapor concentration and a <sup>second</sup> (low) vapor partial pressure is fed to the liquid channel (26) and a two-phase mixture [S]<sub>r</sub>, [G,V]<sub>p</sub> of undersaturated solution [S]<sub>r</sub> with raised vapor concentration and vapor-saturated carrier gas [G,D]<sub>a</sub> with the <sup>first</sup> (same low) vapor partial pressure is carried off, so that when use is made of a cation-generating gas type with the vapor component and cations are formed at the phase boundary (23.2) (gas/liquid/solid) of the first electrode (23) as a result of anodic oxidation with the

wherein said first vapor partial pressure is higher than said second vapor partial pressure

consumption of carrier gas and vapor from the gas channel (25), these migrate transversely to the solution flow through the ion-conducting liquid gap (32) to the second electrode (24) and at its phase boundary (24.1) (gas/liquid/solid) increase the concentration of the solution flowing in the liquid channel (26) as a result of cathodic reduction with the liberation of an equivalent quantity of carrier gas, whilst the electrons from the first electrode (23) flow via the current conduction systems (27,28) and the external load resistor (29) to the second electrode (24), or that when use is made of an anion-generating gas type with the vapor component, anions are formed at the phase boundary (23.2) (gas/liquid/solid) of the first electrode (23) as a result of cathodic reduction with the consumption of carrier gas and vapor from the gas channel (25), these migrate transversely to the solution flow through the ion-conducting, liquid gap (32) to the second electrode (24) and at its phase boundary (24.1) (gas/liquid/solid) increase the concentration of the solution flowing in the liquid channel (26) as a result of anodic oxidation, with the liberation of an equivalent quantity of carrier gas, whilst the electrons from the second electrode (24) flow via the current conduction systems (27,28) and the external load resistor (29) to the first electrode (23). 30

D -- 18 Process according to claim 17, in which the galvanic reaction cell, apart from the ion-generating and system pressure equalizing carrier gas with the vapor component involved in the galvanosorptive reaction process, thermally decomposable into a vapor component and a liquid component vapor-absorbing solution can be fed to and carried off, whereby hydrogen is [a] the cation-generating carrier gas type with the vapor component and

oxygen is <sup>the</sup> anion-generating carrier gas type with the vapor component and the substance system involved in the galvanosorptive reaction process as a whole is at least a ternary one, <sup>whereby</sup> the structural materials of the reaction cell behave inertly in respect of the substance system <sup>selected</sup>.

D -- ~~19~~ Process according to claim 18, <sup>wherein</sup> characterized therein that <sup>an</sup> electrolytic component with negligible inherent vapor pressure soluble in the solvent and increasing the ion-conductivity, is added to the ternary substance system.

D -- ~~20~~ Process according to claim 18, <sup>wherein</sup> characterized therein that the galvanosorptive reaction process taking place in the reaction cell is run adiabatically or non-adiabatically, whereby in the case of non-adiabatic running of the process the electrode in contact with the solution is used whose current conduction system has channels distributed uniformly over its area through which a heat transfer medium flows, whose heat-transferring walls are medium-impermeable. 36

D -- ~~21~~ Process according to claim <sup>36</sup> 20, <sup>wherein</sup> characterized therein that the substance phase quantities conveyed in the circuit by media-conveying devices are measured so that in the galvanosorptive reaction process a constant <sup>remaining</sup> increase in concentration or dilution of the solution and a constant <sup>remaining</sup> vapor depletion of the carrier gas is established, whereby the overall system pressure is adjusted by the carrier gas filling of the circuit and the latter is at the same level as or higher than the upper vapor partial pressure reached in the ternary substance circulation.

D -- ~~22~~ Process according to claim 18, characterized therein that <sup>wherein</sup> an activation voltage source is assigned to the



electrodes which permanently confers on them a quasi electrostatic potential difference [of several volts], whereby this potential difference is superimposed on the inherent voltage difference of the cell.

<sup>36</sup> ~~C~~ ~~23~~ Process according to claim <sup>wherein</sup> [20] characterized therein that the substance flows fed to and carried off from the galvanic reaction cell (40) with external load resistor (41) are formed into an isobaric, ternary substance circuit with external thermal substance decomposition and external phase separation thereby that a heated gas vapor enricher (42) combined with a phase separator, a solution recuperator (43), a solution cooler (44), a phase separator (45), a solution pump (46) and a gas compressor (47), whereby the two-phase mixture [S]r, [G,V]p carried off from the reaction cell (40) is fed above the bottom to the phase separator (45) and the phases [S]r and [G,V]p are separated, the vapor-depleted gas [G,V]p carried off at the head of the phase separator (45) is united with the moderately vapor-depleted gas [G,V]m carried off from the reaction cell and the mixture [G,V]x is fed by the gas compressor (47) to the gas vapor enricher (42) at the bottom and in the latter is conveyed towards the heated vapor-depleting solution [S]r with vapor uptake and the vapor-enriched gas [G,V]r carried off at the head of the gas vapor enricher (42) is fed again to the reaction cell (40), whilst the vapor-enriched solution [S]r carried off at the bottom from the phase separator (45) is conveyed by the solution pump (46) through the secondary side of the solution recuperator (43) (41) and introduced at the head into the gas vapor enricher (42) and the vapor-depleted solution [S]p is carried off at the bottom of the gas vapor enricher (42), passed through the primary side of the

solution recuperator (43) and through the solution cooler (44) and fed again to the reaction cell (40).

① --24. Process according to claim 21, characterized therein that the substance flows fed to and carried off from the reaction cell (50) with external load resistor (56) and connected activation source (57) are formed into an isobaric, ternary substance circuit with external thermal substance decomposition and external phase separation by the allocation of a heated solution heater (51), a gas vapor enricher (52) combined with a phase separator, a phase separator (53), a solution pump (54) and a gas compressor (55), whereby the two-phase mixture [S]r, [G,V]p carried off from the reaction cell (50) is fed above the bottom to the phase separator (53) and the phases [s]r and [G,V]p are separated, the vapor depleted gas [G,V]p carried off at the head of the phase separator (53) is united with the moderately vapor-depleted gas [G,V]m carried off from the reaction cell and the mixture [G,V]x is fed by the gas compressor (55) to the gas vapor enricher (52) at the bottom and in the latter is conveyed towards the heated and vapor-depleting solution [S]r with vapor uptake and the vapor-enriched gas [G,V]r carried off at the head of the gas vapor enricher (52) is fed again to the reaction cell (50), whilst the vapor-enriched solution [S]r carried off at the bottom of the phase separator (53) is conveyed by the solution pump (54) through the solution heater (51) and introduced at the head into the gas vapor enricher (52) and the vapor-depleted solution [S]p carried off at the bottom of the gas vapor enricher (52) is fed again to the reaction cell (50).--